

WHAT IS CLAIMED IS

1           1. A microfabricated fluidic amplifier device, comprising:

2           an elastomer block formed with an input chamber and an output chamber, that  
3       amplifies the pressure in the output chamber relative to the input chamber, wherein fluid in  
4       the input chamber is isolated from fluid in the output chamber.

1           2. The microfabricated fluidic amplifier device of claim 1 wherein the  
2       input chamber is formed in a first elastomer layer and the output chamber is formed in a  
3       second elastomer layer.

1           3. The microfabricated fluidic amplifier device of claim 2 wherein the  
2       second elastomer layer further comprises a third chamber at least partially surrounding the  
3       output chamber.

1           4. The microfabricated fluidic amplifier device of claim 3 wherein the  
2       third chamber is filled with a fluid at ambient pressure.

1           5. The microfabricated fluidic amplifier device of claim 2 wherein the  
2       first elastomer layer comprises a rigid material in the input chamber above the output  
3       chamber.

1           6. The microfabricated fluidic amplifier device of claim 1 wherein the  
2       amplifier device is configured to perform integration.

1           7. The microfabricated fluidic amplifier device of claim 1 wherein the  
2       amplifier device is configured to perform differentiation.

1           8. A microfabricated fluidic switch, comprising:

2           an elastomer block formed with a gate channel and a drain-to-source channel,  
3       that closes and opens the drain-to-source channel in response to pressure changes in the gate  
4       channel,

5           wherein pressure in the gate channel does not need to be increased above, or  
6       decreased below pressure in the drain-to-source channel.

1           9.     The microfabricated fluidic switch of claim 8 wherein the gate channel  
2 is formed in a first elastomer layer and the drain-to-source channel is formed in a second  
3 elastomer layer.

1           10.    The microfabricated fluidic switch of claim 9 wherein a rigid material  
2 is formed on the second elastomer layer in the gate channel.

1           11.    The microfabricated fluidic switch of claim 9 wherein a first chamber  
2 is formed in the second elastomer layer adjacent to the drain-to-source channel.

1           12.    The microfabricated fluidic switch of claim 11 wherein a second  
2 chamber is formed in the second elastomer layer adjacent to the drain-to-source channel.

1           13.    The microfabricated fluidic switch of claim 9 wherein a first chamber  
2 is formed in the first elastomer layer adjacent to the gate channel.

1           14.    The microfabricated fluidic switch of claim 13 wherein a second  
2 chamber is formed in the second elastomer layer adjacent to the drain-to-source channel.

1           15.    The microfluidic switch of claim 8 wherein the switch is a pressure  
2 actuated normally open switch.

1           16.    The microfluidic switch of claim 8 wherein the switch is a pressure  
2 actuated normally closed switch.

1           17.    The microfluidic switch of claim 8 wherein the switch is a vacuum  
2 actuated normally open switch.

1           18.    The microfluidic switch of claim 8 wherein the switch is a vacuum  
2 actuated normally closed switch.

1           19.    A microfabricated fluidic logic device, comprising:  
2           an input channel and an output channel; and  
3           a first microfabricated fluidic switch, wherein the microfabricated fluidic logic  
4 device performs a logic function on an input signal in the input channel to provide an output  
5 signal in the output channel.

1           20. The microfabricated fluidic logic device of claim 19 wherein the  
2 output signal is the inverse of the input signal.

1           21. The microfabricated fluidic logic device of claim 19 wherein the  
2 microfabricated fluidic logic device is an OR gate.

1           22. The microfabricated fluidic logic device of claim 19 wherein the  
2 microfabricated fluidic logic device is a NOR gate.

1           23. The microfabricated fluidic logic device of claim 19 wherein the  
2 microfabricated fluidic logic device is a AND gate.

1           24. The microfabricated fluidic logic device of claim 19 wherein the  
2 microfabricated fluidic logic device is a NAND gate.

1           25. The microfabricated fluidic logic device of claim 19 wherein the  
2 microfabricated fluidic logic device is a flip-flop.

1           26. The microfabricated fluidic logic device of claim 25 wherein the flip-  
2 flop comprises first and second cross-coupled NAND gates.

1           27. The microfabricated fluidic logic device of claim 26 wherein each of  
2 the two NAND gates comprises two pressure actuated normally open switches coupled in  
3 parallel.

1           28. The microfabricated fluidic logic device of claim 25 wherein the flip-  
2 flop comprises first and second cross-coupled NOR gates.

1           29. The microfabricated fluidic logic device of claim 28 wherein the two  
2 NOR gates comprise two pressure actuated normally open switches coupled in series.

1           30. The microfabricated fluidic logic device of claim 28 further  
2 comprising:  
3           first and second step pressure sources coupled to the flip-flop;  
4           a second microfabricated fluidic switch coupled between the first step pressure  
5 source and the first NOR gate;

6                   a third microfabricated fluidic switch coupled between the second step  
7 pressure source and the second NOR gate.

1                   31.       The microfabricated fluidic logic device of claim 28 further  
2 comprising:

3                   a step pressure source comprising an output coupled to the flip-flop through  
4 second and third microfabricated fluidic switches; and

5                   fourth and fifth microfabricated fluidic switches, each coupled between the  
6 output of the step pressure source and ambient exhaust.

1                   32.       The microfabricated fluidic logic device of claim 31 further  
2 comprising:

3                   a first microfabricated fluidic capacitor coupled to an input of the first NOR  
4 gate and the gate of the fourth switch;

5                   a second microfabricated fluidic capacitor coupled to an input of the second  
6 NOR gate and the gate of the fifth switch;

7                   a first fluidic resistor coupled to the first capacitor; and

8                   a second fluidic resistor coupled to the second capacitor.

1                   33.       The microfabricated fluidic logic device of claim 28 further  
2 comprising:

3                   a step pressure source comprising an output coupled to the flip-flop through  
4 second and third microfabricated fluidic switches; and

5                   a fourth microfabricated fluidic switch coupled between the output of the step  
6 pressure source and ambient exhaust, wherein the gate of the fourth switch is coupled to a  
7 clock signal.

1                   34.       The microfabricated fluidic logic device of claim 19 wherein the  
2 switch comprises a pressure actuated normally open switch.

1                   35.       A microfabricated fluidic pressure source, comprising:

2                   a fluidic pump;

3                   microfabricated fluidic first and second unidirectional valves, each coupled to  
4 the pump; and

5                   a microfabricated fluidic reservoir coupled to the second unidirectional valve.

1           36. The microfabricated fluidic pressure source of claim 35 wherein the  
2 pump comprises an elastomeric region with an internal chamber.

1           37. The microfluidic pressure source of claim 35 wherein fluid is forced  
2 through the second unidirectional valve into the reservoir when the pump is compressed or  
3 bent.

1           38. The microfluidic pressure source of claim 35 wherein at least one of  
2 the unidirectional valves comprises a channel in a region of elastomer material, an elastomer  
3 flap, and a stopper in the channel, wherein the stopper prevents the flap from opening the  
4 channel when fluid flows in a first direction through the channel, but not in a second  
5 direction.

1           39. The microfluidic pressure source of claim 35 wherein the reservoir  
2 comprises a chamber inside a plurality of elastomeric layers.

1           40. The microfluidic pressure source of claim 39 wherein an elastomer  
2 layer above the chamber flexes as the pressure inside the chamber changes.

1           41. The microfluidic pressure source of claim 35 wherein the microfluidic  
2 pressure source is a high pressure source.

1           42. The microfluidic pressure source of claim 41 wherein at least one of  
2 the unidirectional valves comprises a microfabricated fluidic pressure multiplier coupled to a  
3 pressure actuated normally closed switch.

1           43. The microfluidic pressure source of claim 35 wherein the microfluidic  
2 pressure source is a vacuum pressure source.

1           44. The microfluidic pressure source of claim 43 wherein at least one of  
2 the unidirectional valves comprises a microfabricated fluidic pressure multiplier coupled to a  
3 vacuum actuated normally closed switch.

1           45. The microfluidic pressure source of claim 35 wherein the microfluidic  
2 pressure source further comprises:

3                 a third unidirectional valve coupled to the second unidirectional valve;  
4                 a fourth unidirectional valve coupled to the third unidirectional;

5                   a first microfluidic capacitor coupled between the pump and the third  
6 unidirectional valve; and

7                   a second microfluidic capacitor coupled between the third and the fourth  
8 unidirectional valves.

1                  46.     The microfluidic pressure source of claim 35 wherein at least one of  
2 the unidirectional valves comprises:

3                   first and second elastomer layers with a first channel there between;

4                   an elastomer spacer in the first channel that is sealed to the first elastomer  
5 layer; and

6                   an elastomer flap sealed to the spacer, but not sealed to the second elastomer  
7 layer which covers a feed through channel in the second elastomer layer.

1                  47.     A microfabricated fluidic switching regulator, comprising:

2                   a microfabricated fluidic pressure multiplier; and

3                   a microfabricated fluidic switch coupled to an output of the pressure  
4 multiplier.

1                  48.     The microfabricated fluidic switching regulator of claim 47 wherein the  
2 switch is a pressure actuated normally closed switch.

1                  49.     The microfabricated fluidic switching regulator of claim 47 wherein  
2 the pressure multiplier has a first input terminal coupled to a high pressure source, and a  
3 second input terminal coupled to ambient exhaust.

1                  50.     A microfabricated fluidic capacitor comprising:

2                   a first elastomer layer comprising a first chamber,

3                   a second elastomer layer comprising a second chamber adjacent to the first  
4 chamber, and wherein the first and second chambers there is no fluid flow between the first  
5 and second chambers.

1                  51.     A microfabricated fluidic unidirectional valve, comprising:

2                   a microfabricated fluidic pressure amplifier coupled between an input terminal  
3 and an output terminal; and

4                   a microfabricated fluidic switch coupled to an output of the pressure  
5 multiplier.

1           52. A microfabricated fluidic unidirectional valve, comprising:  
2           microfabricated elastomer material that has a flow through channel; and  
3           an elastomer flap attached to the elastomer material in the flow through  
4           channel that forms a seal in the flow through channel to prevent fluid from flowing in a first  
5           direction through the flow through channel, and to allow fluid flow in a second direction  
6           through the flow through channel.

1           53. The microfabricated fluidic unidirectional valve of claim 52, wherein  
2           the elastomer material comprises a stopper in the flow through channel that forms a seal with  
3           the elastomer flap when fluid flows in the first direction.

1           54. A microfabricated fluidic device, comprising:  
2           a plurality of input channels and an output channel; and  
3           a first microfabricated fluidic switch, wherein the microfabricated fluidic  
4           device performs a mathematical function on analog input signals in the input channels to  
5           provide an analog output signal in the output channel.

1           55. The microfabricated fluidic device of claim 54 wherein the  
2           microfabricated fluidic device performs addition on the input signals to provide the output  
3           signals.

1           56. The microfabricated fluidic device of claim 54 wherein the  
2           microfabricated fluidic device performs subtraction on the input signals to provide the  
3           output signals.

1           57. The microfabricated fluidic device of claim 54 wherein the  
2           microfabricated fluidic device performs multiplication on the input signals to provide the  
3           output signals.

1           58. The microfabricated fluidic device of claim 54 wherein the  
2           microfabricated fluidic device performs division on the input signals to provide the output  
3           signals.